Remarks:

Claims 1 and 23 have been amended. Claims 13-22 were previously cancelled. Accordingly, claims 1-12 and 23 are currently pending for consideration.

I. Amendments:

Claim 1 has been amended to correct a typographical error in line 4, to correctly recite the transition language "comprising" instead of "comparing." Accordingly, no new matter has been added.

Claim 23 has been amended to delete redundant language. No new matter has been added.

II. The Invention:

The presently claimed invention is directed to a process for producing alkali metal chlorate in an electrolytic cell that is divided by a cation selective separator into an anode compartment in which an anode is arranged and a cathode compartment in which a gas diffusion electrode is arranged. The process comprises introducing an electrolyte solution containing alkali metal chloride into the anode compartment and an oxygen-containing gas into the cathode compartment.

The present invention provides a process for producing alkali metal chlorate which avoids the problems of using alkali metal chromates associated with previously known processes that employ gas diffusion electrodes and avoids the costs and handling problems associated with using considerable amounts of hydrochloric acid and alkali metal hydroxide that are employed in other known processes, while at the same time provides an energy-efficient electrolytic process for the production of alkali metal chlorate and makes a large portion of externally added pH-adjusting chemicals superfluous.

III. Objections/Rejections:

Claims 1 and 23 were objected to because of typographical errors, with claim 1 incorrectly using "comparing" as a transition word and claim 23 using redundant language.

Applicants respectfully submit that these objections are now moot in light of the amendments to claims 1 and 23 and request that the objections be withdrawn.

Claims 1-12 and 23 stand rejected under 35 U.S.C. § 103(a), as being unpatentable over Wanngard (US Pat. No. 5,419,818), in view of Oda et al. (US Pat. No. 4,299,682). The Applicants respectfully traverse.

Wanngard is directed to a process of producing alkali metal chlorate in an energy-efficient manner involving significantly reduced health and environmental hazards making superfluous a large portion of the chemicals added in processes for acidification and alkalization. However, Applicants submit that they are unaware of any disclosure by Wanngard of a cell equipped with a separator that is used to produce the chlorate. To the contrary, Applicants respectfully submit that Wanngard teaches that the chlorate is produced using a non-divided cell and separate chlorate reactor.

The process comprises electrolysis in chlorate electrolyzers of an aqueous electrolyte containing purified alkali metal chloride after which a partial flow of resulting chlorate electrolyte is electrolyzed in a cell equipped with a separator for providing a catholyte which contains alkali metal hydroxide which (alkali metal hydroxide) is used at least partially in the production of alkali metal chlorate (col.2, l.52-59). The electrolysis in the cell equipped with a separator yields an anolyte and a catholyte having lower and higher pH respectively than the chlorate electrolyte supplied to the separator-equipped cell (col.2, l.67-col.3, l.2).

Chlorate electrolyte supplied to the cell with the separator is withdrawn from the reactor vessels or the chlorate electrolyzers (col.3, l.44-46,). The chlorate electrolyte may contain 100 to 1000 g/liter sodium chlorate and 30 to 200 g/liter sodium chloride (col.3, l.44-56). The alkali metal hydroxide-containing catholyte produced in the cell containing a separator can be used for alkalization of the chlorate electrolyte before crystallization of chlorate, in the precipitation of impurities and regeneration of ion-exchange resins, in cell gas and reactor gas scrubbers and for chlorine absorption from the reactor vessels (col.5, l.24-40). Acid anolyte withdrawn from the cell with a separator can be added to one of the flows supplied to the preparation of electrolyte for the chlorate electrolysis (col.5, l.53-55).

From fig.1 and col.6, l.9-64 of Wanngard, it is clearly disclosed that salt slurry is used for preparing electrolyte (2) for producing chlorate together with chlorate electrolyte from reaction vessels (5) and mother liquor from the chlorate crystallizer (8) (col.6, l.12-15). The electrolyte is acidified by adding acid anolyte from diaphragm cell (12) (diaphragm being used as separator) before supply to the cells of the chlorate electrolyzer (4) (col.6, l.20-25). The chlorate electrolyte is conducted from chlorate electrolyzer (4) to reactor (5) where the reaction to form chlorate continues (col.6, l.31-33).

With regard to the above, the chlorate electrolyzer (4) is not a cell divided by a separator. Thus, it is submitted that Wanngard teaches the use of a non-divided chlorate electrolyzer (4) and a separate chlorate reactor (5) in which chlorate is being produced. Applicants submit that Wanngard discloses that a partial flow of chlorate electrolyte is withdrawn to the separator-equipped cell for production of chlorine in the anolyte and alkali metal hydroxide in the catholyte (i.e., no chlorate production), in which the resulting electrolytes may be used to change the pH of the chlorate electrolyte.

Applicants respectfully submit that although the divided electrolytic cell (12) is being supplied with alkali metal chlorate electrolyte, it is not producing alkali metal chlorate. Instead, the electrolyte from the divided cell (12) is transferred to a chlorate electrolyzer (4) from which chlorate electrolyte is transferred to a chlorate reactor (5).

With regard to the section in col.3, l.59-68 cited in the office action, chlorine gas generated in the separator-equipped cell (12) is dissolved immediately in the anolyte succeeded by partial hydrolysis to hypochlorous acid which in turn dissociate to hypochlorite (col.4, l.1-5). Accordingly, Applicants respectfully submit that formation of chlorate is thus not described to occur in divided cell (12). Moreover, Applicants submit that they are unaware of any disclosure by Wanngard of a divided chlorate cell (electrolyzer).

Further, it is submitted that a conventional chlorate cell is non-divided, i.e. has no separator between anode and cathode. In that regard, the "Background of the invention" section of Wanngard, at col.1, l.55-61, sets out that "...chloride electrolyte to be electrolyzed in a chlorate cell must not contain high contents of impurities. Thus, Ca^{2+}, Mg^{2+} and SO_4^{2-} (which may be present as impurities in e.g. sodium chloride solutions) give rise to deposits on the cathodes (in the absence of a separator) while heavy metals decompose formed hypochlorite into chloride and oxygen and not into chlorate as desirable" (col.1, l.55-61). Impurities for the chloride electrolyte may thus reach the cathodes since no ion-selective membrane is hindering transfer of Ca^{2+}, Mg^{2+} and SO_4^{2-} ions in an undivided cell.

Oda et al. disclose a gas diffusion electrode suitable for use in electrolysis of an alkali metal chloride, e.g. for the production of an alkali metal hydroxide or an electrode in a fuel cell (abstract, col.4, l.22-25). However, Applicants respectfully submit that they are unaware of any disclosure by Oda et al. regarding the production of alkali metal chlorate via such an electrode or even the integrated production of chlorine and alkali metal hydroxide for supply thereof to a chlorate cell.

Applicants submit that one skilled in the relevant art would find no reason to modify the teachings of Wanngard in such a way that the instant process is arrived at, since Wanngard is not aiming at providing a divided chlorate cell, particularly not a divided chlorate cell equipped with a gas diffusion electrode, and actually teaches away from such a cell by teaching the use of a non-divided cell and separate chlorate reactor. In that regard, Wanngard discloses and teaches an integrated production of acid and alkali metal hydroxide in a conventional undivided cell, but using a portion of the chlorate electrolyte for production of acid anolyte and alkali metal hydroxide in the catholyte of a divided chloralkali cell.

It is respectfully submitted that a skilled person could thus not foresee that a divided chlorate cell would advantageously contribute to produce integrally acid and alkali metal hydroxide, based on the teachings of the cited references. On the contrary, Applicants submit that, since several parameters differ between divided and undivided chlorate cells including, e.g., mixing conditions of electrolyte, control of pH, need of supplying acid/hydroxide, the skilled person would have no reason to search for the solution (arrived at in the presently claimed invention) in technology describing divided cells, particularly not the Oda et al. reference, which is silent on integrated production of acid and alkali metal hydroxide and production of chlorate.

Accordingly, Applicants respectfully submit that neither Wanngard nor Oda et al., when taken alone or together, disclose, teach or suggest the presently claimed invention.

Therefore, it is respectfully requested that the rejections of claims 1-12 and 23 under 35 U.S.C. § 103(a), as being obvious over Wanngard, in view of Oda et al., be withdrawn.

Conclusion:

In light of the foregoing, Applicants respectfully submit that the application as amended is now in proper form for allowance, which action is earnestly solicited. If the Examiner has any questions relating to this Amendment or to this application in general, it is respectfully requested that the Examiner contact Applicants' undersigned attorney at the telephone number provided below.

Respectfully submitted,

Robert C. Morriss
Attorney for Applicants
Registration No.: 42,910

Akzo Nobel Inc.
Intellectual Property Dept.
120 White Plains Road, Suite 300
Tarrytown, New York 10591
(914) 333-7450